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THREE NEW ANTS RELATED TO *STRUMIGENYS LOUISIANAE* ROGER[1]

By William L. Brown, Jr.
Museum of Comparative Zoology, Harvard University

In this time of high printing costs, the difficulty of publishing in one large work the results of my studies on the ant tribe Dacetini has forced me to break up what would otherwise be a revision in one piece into many smaller treatments. It is hoped that, with the publication after each large natural group of a concise key and other general information, the effect of a revision within the same covers will be approached.

Below are described three new species closely related to *Strumigenys louisianae* Roger, the latter being a common and well-known form ranging from Tennessee and Arizona south through the West Indies and Central America and reaching Bolivia and northern Argentina. *S. louisianae* has been known under several names in different parts of its range (*S. bruchi* Forel, *S. infidelis* Santschi, *S. eggersi cubaensis* Mann and *S. louisianae*, various subspecies and varieties), but all of these names are treated as synonyms in an extended discussion of this form at present in press. A distributional peculiarity of *S. louisianae* seems to be pointed up by the lack of records from the rainforest areas of the Amazon-Orinoco Basins and from the extensively collected Panamanian localities centering on Barro Colorado Island.

The descriptions given are all strictly comparative ones

[1] Published with a grant from the Museum of Comparative Zoology at Harvard College.

drawn against *S. louisianae*. Relationships to other species have not been overlooked, however, as each of the three forms has been compared with all other neotropical species of *Strumigenys* known to me, both described and undescribed, except *S. fusca* and *S. unidentata*, two species to be placed among the *species inquirendae*.

The measurements given are stated in the way standard in recent publications dealing with the dacetine ants. Abbreviations: TL, "total" or synthetic aggregate length of body, including mandibles; HL, maximum measurable length of head proper; ML, exposed length of mandibles; WL, (Weber's) diagonal length of alitrunk, lateral view; CI, cephalic index, or maximum head width expressed as a percentage of HL; MI, mandibulocephalic index, or exposed length of mandibles expressed as a percentage of HL.

Material studied originated from, and is redeposited in, the W. M. Mann and National Museum Collections, United States National Museum (USNM); Borgmeier Collection, Petropolis, Brazil; series are also placed by exchange in the Museum of Comparative Zoology, Harvard University (MCZ). Thanks are due Father Thomáz Borgmeier, Dr. W. M. Mann and Dr. M. R. Smith for the privilege of examining the above-mentioned series.

All three species, like *S. louisianae*, belong to the nominate subgenus of *Strumigenys*.

Strumigenys clasmospongia new species

Holotype worker: TL 2.57 mm., HL 0.60 mm., ML 0.39 mm., WL 0.58 mm., CI 74, MI 65.

Similar to *S. louisianae*, but differing in its larger, distinctly more slender body and relatively much longer mandibles, and also in the following details:

(1) Promesonotum with a fine but distinct median longitudinal carinula; lateral carinuliform margins also more distinct, and on each side of the mesonotum forming a low, rounded translucent flange; posterior to each of these flanges is a second smaller, but similar flange at each posterior mesonotal corner. Homologous, but much less distinct flanges may sometimes be seen in *S. louisianae* workers.

(2) Metanotal groove as distinct as in *S. louisianae* or slightly more so; posterior mesonotal region a bit more strongly concave and slightly more distinctly constricted.

(3) Petiolar node with a more slender peduncle and the anterior face not so strongly obliquely depressed, the summit rather evenly rounded in profile seen from the side; node only slightly broader than long seen from above.

(4) Dorsum of postpetiole for the most part smooth or nearly so, definitely shining. Gastric dorsum at base with a few feeble costulae, basal tergite only feebly reticulate (covered with a whitish dried film possibly representing a secretion) and with anterior part subopaque, but sides and posterior half moderately but definitely shining. Sculpture over entire body a trifle weaker than in *S. louisianae*.

(5) Pilosity in general a little less abundant and conspicuous; ground pilosity vestigial on alitruncal dorsum. Color ferrugineous.

Holotype (Borgmeier Coll.) taken at Petropolis, State of Rio de Janeiro, Brazil; "gesiebt. Nr. 5884" (T. Borgmeier leg.)

Paratypes: 5 workers (Borgmeier Coll., USNM, MCZ) with data as for holotype. TL 2.54-2.76 mm., HL 0.60-0.65 mm., ML 0.39-0.41 mm., WL 0.58-0.62 mm., CI 71-76, MI 63-66.

Strumigenys producta new species

Holotype worker: TL 2.91 mm., HL 0.65 mm., ML 0.45 mm., WL 0.70 mm., CI 81, MI 69.

Very similar to *S. louisianae*, but larger, more slender, and with much longer mandibles. Dentition as in *S. louisianae* and *S. clasmospongia*, that is, with a single small preapical tooth and two acute intercalary denticles to the apical fork. Also the following differences from S. *louisianae*:

(1) Propodeal spines more slender and acute, rather strongly elevated, divergent, longer than the distance between the centers of their bases.

(2) Gastric tergite I with fine basal costulae extending

1/3 its length, remainder of its surface only very feebly and superficially reticulate, definitely shining.

(3) Petiole slender, with a long, slender peduncle and subglobose node; posterior spongiform collar vestigial; cariniform.

(4) Ground pilosity of alitrunk reduced and mostly inconspicuous. Color light ferrugineous; appendages, etc. and base of gaster lighter, more yellowish.

Holotype (Mann Coll., USNM) one of a series of 15 workers in the type series, taken at Rurrenabaque, Rio Beni, Bolivia (W. M. Mann leg.)

Paratypes: (USNM, Coll. Borgmeier, MCZ) Remaining 14 workers of type series, same data. TL 2.85-3.06 mm., HL 0.65-0.70 mm., ML 0.45-0.48 mm., WL 0.69-0.74 mm., CI 78-82, MI 69-70. Color varying from yellowish- to medium-ferrugineous.

Strumigenys mixta new species

Holotype worker: TL 2.32 mm., HL 0.54 mm., ML 0.31 mm., WL 0.54 mm., CI 83, MI 57.

Differs significantly from *S. louisianae* only in the following details:

(1) Inner mandibular border with an extra minute denticle slightly basad of the apical third of the ML.

(2) Pilosity decidedly narrower and less conspicuous, especially on the posterior cephalic dorsum. Paired, outstanding hairs, one on each lateral occipital border, each humeral angle and each side of the mesonotum are all finely flagelliform, whereas in *S. louisianae*, the lateral occipital and mesonotal hairs are stiff and spatulate towards their apices.

(3) Metanotal groove completely or very nearly completely obsolete; in profile from lateral view, the posterior alitruncal dorsum continuous in outline, not interrupted by the notch at the metanotal groove as in *S. louisianae*.

Color light ferrugineous yellow.

Holotype (USNM) one of 15 workers taken at Escuintla, Guatemala (W. M. Mann leg.).

Paratypes: 14 workers from type nest series, same data

as for holotype, and 5 workers from orchid plants (*Cattleya bowringeana*) shipped from San José, Guatemala and intercepted in U.S. Plant Quarantine at San Francisco, California (SF 20739 Supl.; 46-5348). Deposited in USNM and MCZ. TL 2.14-2.49 mm., HL 0.51-0.59 mm., ML 0.28-0.32, WL 0.51-0.60, CI 80-84, MI 54-60. The Escuintla (type nest) series is made up of mostly smaller, yellow individuals, while that from San José contains workers mostly in the upper part of the size range given and medium ferrugineous or deep burnt-orange in color. Means of dimensions, but not of proportions, differ slightly, but there is also an absolute overlap. The color difference is not considered taxonomically significant in the face of similar variation seen in many other dacetine species. The name *mixta* refers to the intermediate characters, seemingly linking *S. louisianae* and *S. emeryi* Mann, but also distinguishing this species from both.

OBSERVATIONS ON THE REPRODUCTION OF THE GIANT COCKROACH, *BLABERUS CRANIIFERA* BURM.

By W. L. Nutting
Biological Laboratories, Harvard University

In his *Embryology of the Viviparous Insects,* H. R. Hagan (1951) cites nine species of roaches recorded as exhibiting some type of viviparity, or oviparity approaching viviparity. Chopard (1950) and Van Wyk (1952) have furnished two additional examples of viviparous blattids. Much of the evidence for viviparity has been indirect; that is, it has been based on dissections of gravid females, while in scarcely half the cases has the birth process actually been witnessed. Among the species mentioned by Hagan are the West Indian *Blabera fusca* Brunner (Saupe, 1929), and a Bolivian *Blabera* species (Holmgren, 1903). (*Blabera fusca* Brunner can probably be referred to *craniifera* Burm. according to Rehn and Hebard (1927).) Over the past seven years I have had the opportunity to observe rather closely a flourishing culture of *Blaberus craniifera* Burm., originally started from Florida specimens by Prof. C. T. Brues. (This roach is limited to Cuba in the West Indies and ranges from southern Mexico to British Honduras on the mainland; it has undoubtedly been introduced to Key West from Cuba.) During this period I have found newly hatched nymphs dozens of times, but only recently have I observed parturition itself. Before recounting this event, it seems appropriate to include available information on mating, the little-known spermatophore, and other relevant details on the reproductive habits of this large laboratory roach.

Blaberus is rarely active during the daytime, even in the laboratory, and I have never seen courting behavior. However, Saupe (1929) described the one case of love play and copulation for *B. fusca* which he observed during daylight. The actions were generally much like those detailed for

some of the more common roaches (see Roth, 1952), except that no dorsal glands are known which attract and engage the female as in *Blattella*. The male vibrates his antennae and goes through brisk quivering motions, sometimes raised up on his legs. After contact stimuli from the interested female he raises his wings, while the female advances over his abdomen as far as his raised wings to the "female superior pose". As the male makes contact with the female's genitalia, they simultaneously turn in opposite directions to complete copulation in the "false-linear position" which is typical for the roaches. The pair observed by Saupe remained together for 80 minutes, but I have noted many pairs together for four hours and more which is much longer than is usual for most roaches.

Many texts list the occurrence of spermatophores in certain members of the Thysanura, Odonata, Neuroptera, Lepidoptera, Coleoptera, and several subgroups of the Orthoptera. Until recently, oddly enough, it was not generally known that this method of sperm transfer is also used by at least some of the blattids. Zabinski (1933) first described and figured the spermatophore for *Blatta orientalis,* while Qadri (1938) reported some conflicting observations on spermatophore formation for the same species. Hagan (1941) mentioned the genital pouch as a receptacle for the spermatophore in *Diploptera,* but did not describe it. The spermatophore of *Periplaneta americana* was described and figured in position by Gupta (1947). The formation of the spermatophore of *Blattella germanica* is described and discussed by Khalifa (1950). Roth (1952) presented notes on the spermatophores of *Blattella, Blatta,* and *Periplaneta.* Recently Van Wyk (1952) described the spermatophore of *Leucophaea maderae.* The present observations on *Blaberus* now make a total of five subgroups of the Blattaria which are known to form spermatophores. This strengthens Khalifa's presumption that spermatophores are of general occurrence among the roaches.

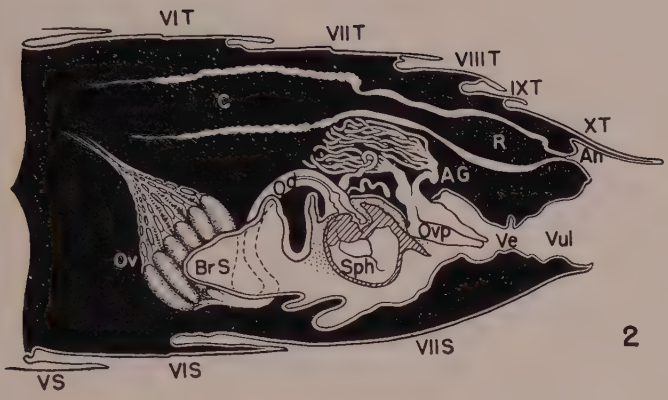
Figs. 1 and 2 show the position of the spermatophore (Sph) in *Blaberus* shortly after copulation. The freshly deposited spermatophore is a tailed, pearly-white spheroid, about 3.5 mm. in diameter. A clear, jelly-like mass fills

the vestibule (Ve) and cements (stippled area) the spermatophore into the genital pouch. According to Qadri the spermatophore of *Blatta* contains a number of sperm capsules, while Khalifa and Van Wyk described two sperm sacs in those of *Blattella* and *Leucophaea*. In *Blaberus* the spermatophore is irregularly divided into a small and a large compartment, while two sperm ducts lead from the larger one to oppose the spermathecal orifices. Whereas most of the roaches previously noted have not retained their spermatophores longer than 24 hours before dropping them, one *Blaberus* female was noted to retain her spermatophore intact for five days, when on the sixth day a mass of chalky fragments and greyish jelly was observed in her genital pouch.

As in the other roaches which retain their eggs for a considerable time, the oötheca resembles a thin, transparent plastic bag drawn tightly about the eggs. It is quite smooth and, as it varies in thickness, a dull ochreaceous to a bright chestnut in color. A point which has previously been overlooked in *Blaberus* is that the oötheca is not complete, so that the micropylar end of each egg is plainly visible through a slit usually wider than one egg. The extremely delicate oötheca of *Diploptera* as described by Hagan, never covers more than half of each oöcyte, and may not even cover the older eggs. Although *Blaberus* does not approach this extreme, the pro- and mesothorax of each embryo are virtually free of the oötheca shortly before birth. This open type of oötheca may be of some importance to embryonic respiration within the brood pouch as suggested by Hagan. The elaborate arrangement of air tubes through the keel of the conventional armored roach oötheca (Lawson, 1951)

EXPLANATION OF PLATE 1

Fig. 1. *Blaberus craniifera* Burm. Ventral dissection of female reproductive system showing spermatophore (Sph) cemented (stippled area) into the genital pouch over the gonopore. The posterior ventral wall of the genital chamber has been removed. Fig. 2. Sagittal section through region shown in Fig. 1. AG, accessory gland; An, anus; BrS, brood sac; C, colon; Od, oviduct; Ov, ovary; Ovp, ovipositor; R, rectum; S, sternite; Sph, spermatophore; T, tergite; Ve, vestibule; Vul, vulva.



NUTTING — BLABERUS CRANIIFERA

would certainly be unnecessary, if not actually impractical here.

One of the largest oöthecae I have seen contained 45 eggs and measured 8 x 35 mm., while an unusually small one containing 23, probably from an old female, measured 4 x 16 mm. The average number of eggs found in 14 oöthecae was 36.4. Saupe (1929) gave an average of 23.25 eggs for 8 oöthecae, ranging from 11 to 38 per oötheca in *B. fusca.* Stewart (1925) reported an oötheca ¼ x 1½ inches containing 44 eggs from a specimen of *B. cubensis* Saussure. (Rehn and Hebard (1927) refer this species to *B. discoidalis* Serville.) Two oöthecae of the Central American *B. trapezoideus* Burm. measured 7 x 35 and 4.5 x 31 mm., and contained 40 and 41 eggs respectively. *Diploptera,* which has been more thoroughly studied than any of the viviparous roaches, exhibits a pseudoplacental type of viviparity and forms an oötheca normally containing but 12 eggs. All other known viviparous roaches produce many more eggs at a time, the numbers per oötheca generally falling within the limits reported for these three species of *Blaberus.*

While in the brood sac, all the eggs in an oötheca have the micropylar ends directed toward the left. The smallest eggs found in newly formed oöthecae measured 1.7 - 2.0 x 4.5 - 5.0 mm.; the largest, shortly before hatching, 2.5 x 8.2 mm. In the young germ band stage the pleuropodia resemble short, thick-stalked, immature mushrooms, and project back to the posterior margin of the second abdominal segment. In the chitinized embryo, shortly before they are resorbed, they appear as long, thin-stalked mushrooms extending to the middle of the third abdominal segment. They consist of a base and bulb only; there is no evidence of any pleuropodial extension as found in *Diploptera.* The eggs contain a large amount of yolk, and a considerable amount is present shortly before hatching. In the absence of any embryological studies on *Blaberus,* little more can be said concerning embryonic nutrition; it does not seem likely that the mother provides any more than the original yolk.

Many times I have seen females with a newly formed

oötheca protruding about two-thirds of its length from the brood sac. Some of these females were segregated, and their oöthecae were usually completely returned into the brood sac within a short time. This act apparently signals the completion of an oötheca and the beginning of the incubation period, as has been observed in *Gromphadorhina* by Chopard (1950). Neither the duration of gestation nor the span of female reproductive life is known for any of the species of *Blaberus*, although the former may last for more than two months. Females sometimes discard an oötheca; this has occurred most notably after the roaches have been disturbed and handled during cage-cleaning. Except in two cases noted below, none of these oöthecae has been known to hatch.

Recently a relatively inactive female was found with about half the length of her oötheca extruded from the brood sac. At least the pro- and mesothorax of each visible embryo were free of the oötheca. The ensuing events of hatching were observed under a low-power dissecting microscope. All of these embryos were rapidly swallowing air, and the bubbles could easily be seen passing through the head capsule into the enlarging crop. Within 2 or 3 minutes the embryonic cuticle on one individual had split; after 60 to 90 seconds, with some side to side struggling, it was free. Although the abdominal movements of the female indicated that she was trying to expel the oötheca, she was unable to extrude more than three-fourths of its length. I therefore removed the egg case, and within 10 minutes all but four unfertile eggs had hatched.

On becoming free the embryos gradually stopped swallowing air; at this point they were cylindrical and about 10 mm. long. They began telescoping their abdominal segments and within a few seconds they had assumed a flattened roach-like appearance measuring about 7 mm. long. The air is probably expelled through the mouth. The young roaches do not leave the mother but swarm over the oötheca practically consuming it in a short time. Saupe (1929) suspected the mother of devouring the oöthecal remains. A degree of maternal solicitude is exhibited by this roach, for many times I have observed the female to remain

motionless for an hour or more with her unpigmented brood clustered around and beneath her body. The nymphs are completely pigmented in about 6 hours. I have recorded the next molt as occurring within 15 to 36 days for four different broods.

Although deposited oötheca generally do not hatch, a mature one, picked up two days after the cage had been cleaned, did hatch after considerable handling. While examining another oötheca six days after its deposition, it was noted that the embryos were swallowing air. Slight pressure on the oötheca while held between the fingers finally resulted in the successful hatching of 14 normal nymphs. Two more nymphs were obtained from this same oötheca upon considerable manipulation ten days after its deposition. On numerous other occasions mature oöthecae have been kept in humid petri dishes for two or three weeks without hatching. The hearts of these embryos continued beating until they finally died from mold or desiccation. These observations strongly suggest that the pressure exerted by the female on the oötheca during extrusion supplies the necessary hatching stimulus. Unless some such stimulus is applied to initiate the air-swallowing, mature embryos remain helplessly encased until death.

The fine line separating ovoviviparity from viviparity seems to be whether or not the embryos hatch before deposition. By strict definition, this single reported observation on the birth of *Blaberus* nymphs would qualify it as an ovoviviparous insect. Many more observations would be required to determine whether the female generally retains the oötheca while the majority of the embryos hatch; it appears to me quite impossible for the event to take place within the confines of the brood sac itself. Although this categorizing is relatively unimportant, the features which place this fine laboratory insect between the more common oviparous roaches and the viviparous *Diploptera* are worth noting.

The ovarioles have not been reduced in number (16 to 23 per ovary as opposed to 6 in *Diploptera*), and the accessory glands are not as highly modified as in *Diploptera*. Even though each oötheca contains a large number of eggs,

the period between oöthecae may be measured in weeks rather than in days as in *Periplaneta* (Gould and Deay, 1940). The brood sac is very large, and the development of the genital pouch approaches that of *Diploptera*. Lastly, the oötheca is soft, thin, and open, and is retained in the brood sac until hatching. In summary, the major modifications toward viviparity in *Blaberus* have occurred in the mother and not in the embryo.

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Nemestrinidae (Diptera) of Iowa and Missouri. — A small collection recently sent by Mr. Jean L. Laffoon, at Iowa State College, contains a male of *Neorhynchocephalus sackenii* (Williston) collected at Sioux City, Woodbury Co., Iowa, June 10, 1949, by J. A. Slater and J. L. Laffoon. It was taken immediately above the mouth of the Sioux River, on top of the loess hills which border the Missouri River in western Iowa. Mr. Laffoon points out to me that this area contains some plants and animals ordinarily found only farther west. It is the first record for any of the Nemestrinidae in Iowa. Specimens of *N. sackenii* were also collected at Washington University Farm, 7 miles southwest of Clarksville, Pike Co., Missouri, by Mr. Robert A. Dietz, of the University of Tennessee. *N. sackenii* is now recorded from British Columbia and the states of Washington, Oregon, Montana, California, Idaho, Wyoming, Utah, Arizona, Colorado, New Mexico, Kansas, Oklahoma, Arkansas, Missouri, Iowa, Michigan, and Illinois. I have seen specimens from Huachuca Canyon, Cochise Co., Arizona, August 17, 1950 (R. L. Langston). It is remarkable that there are as yet no records from Mexico. — J. Bequaert, Museum of Comparative Zoology, Cambridge.

ON FLANDERS' HYPOTHESIS OF CASTE DETERMINATION IN ANTS*

By Edward O. Wilson
Biological Laboratories, Harvard University

S. E. Flanders (1945, 1952) has recently advanced a hypothesis concerning caste determination in ants which has gained wide recognition. According to Flanders, the nutritive material available to the female embryo in the egg determines the developmental path it will follow as a larva, producing finally a queen or one of the worker subcastes. The available nutritive material is assumed to be a function of the degree of ovisorption, since this has been shown to be the basis of discontinuous variation in several terebrant Hymenoptera. The degree of ovisorption in turn is assumed to be a function of one or more environmental influences affecting the queen. One of the ways the environment can act is through its effect on the rate of oviposition, which is probably inversely related to the degree of ovisorption.

What appears to be the crux of Flanders' hypothesis is stated as follows in his 1952 paper: "Since the worker caste is characteristic of all non-parasitic ants, irrespective of the wide variation in the larval nutrition of the various species, it is evident that any trophic influence on caste formation must be made effective through an agency common to all ant colonies. Such an agency is most likely to consist of a set of conditions resident in the queen. Morphological differentiation would be initiated therefore prior to egg deposition."

* Dr. Flanders has recently published the paper read at the December 1952 meeting of the American Section of the International Union for the Study of Social Insects (Scientific Monthly, 76: 142-148, 1953). This contains an extensive elaboration of his hypothesis, with heavy emphasis on examples drawn from the terebrant Hymenoptera, but presents no new experimental evidence bearing on ants and does not take into account the objections raised by myself at the original reading and presented once again in the following paper.

From the onset this line of reasoning appears weak, since it is obvious that the environment of the ovary is by no means the only condition affecting individual development which is common to all ant colonies. Colonial organization and the details of individual postembryonic development are fundamentally the same for all ants and are amenable to the establishment of any number of physiological mechanisms controlling caste differentiation. To settle on one specific mechanism without supporting evidence is to engage in almost pure speculation. Since a great deal of new information bearing on this subject has been brought to light in the past decade, a reevaluation of Flanders' suggestions and of the literature pertinent to them is warranted at the present time.

One does not need to look far to find that Flanders' hypothesis is contravened by a considerable body of evidence, much of it resting in the literature. While it is possible that the differences in yolk content which are presumed to underlie caste differentiation may be so subtle as to escape the eye of the casual myrmecological observer, it still should be taken as significant that variation in egg size and content have rarely been recorded in the literature and then have been shown definitely not to correlate with caste differentiation (Eidmann 1931, Ledoux 1950). Some effort has actually been made to demonstrate caste differences at the level of the egg, as in the work of Bhattacharya (1943) on *Oecophylla smaragdina* (Fabricius), but with negative results. Direct evidence against the hypothesis may be supplied by the work of Ledoux (1949, 1950) on *Oecophylla longinoda* (Latreille). In this species the workers act as supplementary reproductives and can produce males, queens, and major and minor workers with equal facility. Two sizes of eggs are laid, averaging in length 0.6 mm and 1.1 mm respectively. The larger size yields males, the smaller, any of the three female castes. The fecundated female, on the other hand, lays eggs all of the same size, averaging 1.2 mm in length, from which proceed either workers (at least) or males. Ledoux has offered the logical explanation that the smaller worker eggs produce females and not males, as would be expected

from unfertilized eggs, because they are laid prematurely and at least some time before the first meiotic division. But whatever the explanation, the important point considered here is that workers can develop from eggs of either of the two different sizes, whereas queens develop from at least the *smaller* of the two sizes. While it is true that the size of the *Oecophylla* egg may not absolutely determine yolk content, yet it seems very probable that the differences in yolk content between two such markedly distinct egg sizes would greatly outweigh the very slight differences that must be assumed to determine caste in the worker-laid egg if Flanders' hypothesis is correct.

The preponderance of available evidence seems to indicate that the caste of female individuals is determined in the larval period, without regard to the original condition of the egg. The work of Wesson (1940), Goetsch (1937), and many others in the past half century has shown that larval feeding plays a major role; an excellent review of this work is presented by Light (1942-43). Gregg (1942) has shown that the major-minor ratio in colonies of *Pheidole morrisi* Forel affects significantly the ratio of these castes appearing in the brood, and he has offered as the simplest explanation that this condition originates through trophic influences, possibly ectohormonal, on the developing larvae. Recently, Brian (1951) has outlined his preliminary results from current work on caste determination in *Myrmica rubra* L. The threshold for queen-worker divergence is reported to be in the larval period; in order to attain queenness an overwintering larva must reach by a certain time a weight of about 6.5 milligrams. It must then race to reach another threshold in order to become a fully developed queen; if it fails, it ends its development abnormally small or as an intercaste. Ledoux (*op. cit.*) presents convincing evidence that in *Oecophylla longinoda* the threshold for queen-worker divergence is in very early larval life, while the threshold for major-minor divergence is at some time in the second larval stadium. In the work of both Brian and Ledoux it is especially noteworthy that larval nutrition and larval size are apparently the major factors involved.

The present writer (Wilson 1953) has shown that all stages of polymorphism in ants can be explained on the basis of simple or modified adult allometry and correlated changes in the frequency distribution of size. The greater part of the differential growth underlying this allometry must occur no sooner than the prepupal stage, when the gross adult form is laid down by the proliferation and deployment of the pupal hypodermis. Certain finer details of allometry may not become apparent until later at the onset of adult development. The allometric character of the castes is obscured in the case of complete dimorphism, or queen-worker and major-minor segregation, in which the intermediates drop out and the log-log allometric regression curves of the two castes become disaligned. Dimorphism can be explained simply on the basis of abrupt changes in the specific growth rates of the imaginal discs of various organs at critical sizes or under certain physiological influences, a phenomenon which has been demonstrated to be fundamental in the ontogenetic growth of many other groups of animals (Teissier 1934, Yasumatsu 1946). Queen-worker divergence, preceding in ontogeny the allometric differentiation of the worker subcastes, probably is initiated at a critical time by the fixing in the imaginal discs of one of two alternative specific-growth-rate potentials; this is attended by an approximate regulation of the course of larval development. A second threshold of this type may be introduced at a later stage of larval development in the case of major-minor dimorphism. As stated previously, the important specific-growth-rate potentials are completely expressed only at or after the onset of pupal development prior to the last larval ecdysis. This means that differentiation of female castes at all levels is probably a function of size, whether in the attainment of a threshold size in larval development, in the case of dimorphism, or in the relation of gradient allometric growth to the total size reached at the termination of larval development, in the case of the more elementary stages of polymorphism.

If an attempt is made to fit Flander's hypothesis to this concept, it seems to force the proposition that the nutritive

material in the egg determines caste by predetermining exactly the size reached by a larva at various stages of its development. Such a proposition would be wrong, of course, since it is a commonly observed fact that the growth of larvae can be changed greatly by simply varying the amount and kind of food supplied the colony. It appears to the present writer that Flanders' explanation has a good chance of holding only under certain conditions of complete dimorphism. It is not impossible that in extreme cases the critical developmental time mentioned above can be pushed back in ontogeny all the way through the larval period and to the embryonic period within the egg, so that the imaginal disc potentials are already fixed at the time of eclosion from the egg. On the other hand, ovisorption might exercise a subsidiary influence in caste determination by statistically affecting the *chances* of a larva attaining the important size levels during its growth; existing data on larval development are not complete enough to evaluate this particular aspect. Whether ovisorption ever actually plays these two roles remains to be seen, but at the present time this outstanding fact must be accepted: there is no direct evidence upon which to base such an assumption.

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TWO NEW SPECIES OF WATER BEETLES FROM FLORIDA (COLEOPTERA: DYTISCIDAE)*

By Frank N. Young

The two new species of Dytiscidae described below were encountered during the course of the writer's investigations of the species comprising the genera represented in the Florida fauna.

The new *Hydrovatus* is remarkable in that it is apparently confined to the peninsular region of Florida and may represent an endemic form originally isolated on the Pleistocene Islands. Examination of the type of *Hydrovatus indianensis* Blatchley convinces me that it is not that species although the two are similar. The occurrence of "giant" forms within the limits of the populations of *H. pustulatus* Melsheimer and *compressus* Sharp respectively suggests the possibility that they may represent mutant or even polyploid species.

The new *Copelatus* has stood on our lists for many years as *C. debilis* Sharp, but a comparison of Blatchley's specimens with true *debilis* indicates that the two are distinct. The form is probably not restricted to the Florida Keys, unless those islands represent the remnants of a land mass more ancient than we now suspect.

Hydrovatus peninsularis sp. nov.

Diagnosis: A moderately large, dark colored *Hydrovatus* resembling in general *H. indianensis* Blatchley, but differing from that species in color pattern and in punctation. From *H. major* Sharp or *horni* Crotch it differs in lacking conspicuous sulci on the sides of the elytra. From *H. pustulatus* Melsheimer and *compressus* Sharp it differs in its

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larger size, different coloration, and in the structure of the male genitalia. Total length ranges from 2.9 to 3.1 mm.; greatest width from about 1.9 to 2.1 mm. Average size based on measurements of eight specimens about 2.98 by 1.96 mm. *H. compressus,* the only species so far taken in company with *peninsularis,* averages about 2.31 by 1.58 mm. *Peninsularis* may represent a form of *indianensis,* but that species is still so rare in collections that I have had no material available for comparison except the unique female type.

HOLOTYPE MALE: Form broadly oval, nearly hemispherical. Outline of body when viewed from above broadest at base of elytra, not much narrowed anteriorly, but narrowing posteriorly from the humeri with a slight sinuation near the middle of the elytra beyond which the elytra narrow again to the acuminate tips. Strongly convex above and below. Total length 2.92 mm.; greatest width 1.98 mm. Width at base of pronotum 1.81 mm.; width at apex of pronotum 1.13 mm.; length of pronotum at midline 0.76 mm. Length from base of prosternal process to apex of coxal lamina 1.43 mm. Width between eyes 0.73 mm. *Head*: Microreticulate with some irregularly spaced, moderately fine punctures. (Coarser punctures along inner margin of eyes and on front in usual position for genus.) Clypeus inconspicuously margined. Microsculpture of vertex with meshes regular and rather deeply impressed. *Pronotum*: Microsculpture much as on head. Punctation much coarser than on head, coarse and dense along anterior and posterior margins but somewhat finer and sparser on disk and toward sides. Punctures at apex and base of pronotum with some tendency to coalesce to form vermiculate sculpture. *Elytra*: Microsculpture less deeply impressed than on either the head or the pronotum (surface appearing more strongly polished). Punctation coarser than on pronotum and arranged in roughly regular rows or striae running from base toward apex. (Three striae of hair bearing punctures vaguely discernible on each elytron). Apices and lateral margins of elytra less densely and more finely punctate than disk. A number of coarse punctures extending posteriorly from the humerus of each elytron

apparently occupy the same position as the sulcus seen in *major* and *horni*. Below these punctures there is a vague longitudinal ridge above the epipleura. *Venter*: Metasternum slightly more coarsely and irregularly punctate than the elytra. Hind coxal plates with very large punctures separated from one another by less than their own diameter and in part confluent (punctures much coarser than those of elytra; about as coarse as those of elytra in *indianensis*). Two basal abdominal sternites with a few coarse punctures; other sternites with microsculpture but not conspicuously punctate (two basal abdominal sternites very coarsely and confluently punctate in *indianensis*). Terminal abdominal sternite mucronate but without a median ridge (with a blunt projecting ridge and not strongly pointed in the female type of *indianensis*). Epipleurae with some coarse, irregularly spaced punctures. *Anterior* and *middle tarsi*: Moderately strongly dilated. Anterior protarsal claw slightly broader and blunter than its fellow. *Genitalia*: Similar to those of *compressus* and *pustulatus*, but with the parameres more evenly rounded at the tips, and with the aedeagus with the constricted apical portion relatively longer, stouter, and less strongly curved down at the tip. *Color*: Head nearly uniformly reddish brown. Pronotum with disk dark reddish brown and the lateral margins lighter; base and apex somewhat darker, but no lighter cross-bar between them as in *indianensis*. Elytra dark reddish brown, each with a transverse sub-basal yellowish brown spot which reaches the lighter margin at the side but does not attain the suture, a postmedian yellowish brown spot, and the apices yellowish brown. Venter reddish brown with the metasternum and hind coxal plates darker. Color pattern similar to that of *indianensis* but differing in the narrower sub-basal spot and the larger postmedian spot, as well as in the lack of a light cross-bar on the pronotum.

ALLOTYPE FEMALE: Similar to the male but somewhat more regularly oval, somewhat darker in general color, the elytra less polished and with the anterior and middle tarsi less strongly expanded. Total length 2.93 mm.; greatest width 1.97 mm. Width at base of pronotum 1.62 mm.;

width at apex of pronotum 1.16 mm.; length of pronotum at midline 0.76 mm. Length from base of prosternum to apex of coxal lamina 1.48 mm. Width between eyes 0.78 mm.

VARIATION: Paratypes differ somewhat from the types in coloration and in the coarseness of punctation. The punctation of the pronotum in some is coarser, in others finer than in the types.

TYPE LOCALITY: Holotype and allotype from: FLORIDA: Alachua County, Lake Newman east of Gainesville, Sept. 27, 1939 F. N. Young. Paratypes from: FLORIDA: Alachua County, Bivan's Arm of Payne Prairie south of Gainesville, Feb. 1939 F. N. Young (4 ♀); Lake Wauberg near Micanopy, Apr. 30, 1938, F. N. Young (1 ♀); Polk County, Saddle Creek Canal, 1 mi. north of Bartow, Nov. 1, 1951 Ellis Lanquist (1 ♂); and Brighton (Okeechobee), June 16, 1929, P. J. Darlington Jr. (10 exs.).

LOCATION OF TYPES: Holotype, allotype and two female paratypes are in the University of Michigan, Museum of Zoology, Ann Arbor. One male paratype is in the collection of Ellis Lanquist at the Department of Biology, University of Florida, Gainesville. One female paratype is in the collection of H. B. Leech at the California Academy of Sciences, and another in the W. S. Blatchley collection at Purdue University, Lafayette, Indiana. The Brighton paratypes are in the Museum of Comparative Zoology (Type No. 29,018), Cambridge, Massachusetts.

Copelatus blatchleyi sp. nov.

1919 *Copelatus debilis* Blatchley, not of Sharp, Bull. Amer. Mus. Nat. History, 41 (4) :312.

1932 *Copelatus debilis* Blatchley, not of Sharp, "In Days Agone . . .," Nature Publishing Co., Indianapolis, p. 293.

The *Copelatus* recorded by Blatchley from Florida (see above) represents a species resembling, but very distinct from *debilis* Sharp as represented by specimens from Texas, Mexico, and Central America. Blatchley (1932) states that his specimens were sifted from among dead leaves about 200 yards from tidal pools near the cemetery at Key West. He surmises that the species may be a

brackish water form, but from the situation cited *blatchleyi* will more likely be found associated with the ephemeral rain pools which form in the broadleaved evergreen jungle hammock associes of the Keys. It will probably also be found in the West Indies.

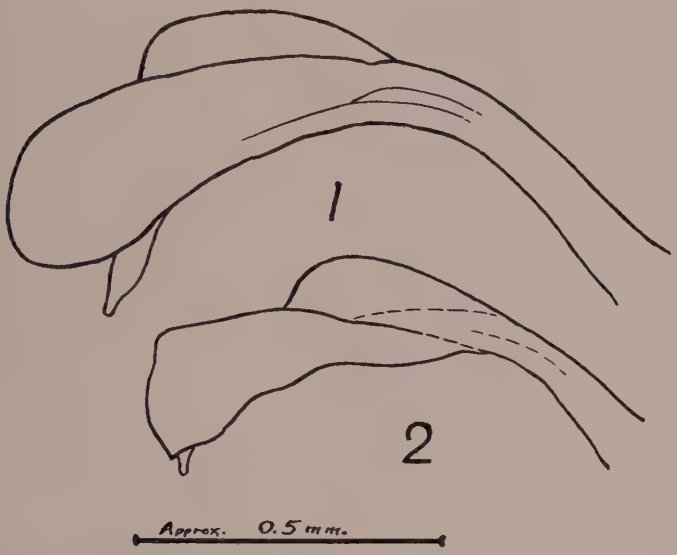


Fig. 1. Lateral outline of aedeagus of holotype of *Copelatus blatchleyi* from Key West, Florida. Fig.2. Lateral outline of aedeagus of *Copelatus debilis* from Brownsville, Texas. (Both figures drawn to same scale)

Copelatus cubaensis Schaeffer (Jour. New York Ent. Soc., 16: 18, 1908) seems from the description to be very similar to *blatchleyi,* but is described as having a submarginal and six other striae on each elytron. A comparison of the male genitalia should help to determine the relationships of several forms which we now place in different groups almost entirely on the number of striae on the elytra. The genitalia of *debilis* and *blatchleyi* are of a similar type radically different from those of *glyphicus* or *chevrolati. C. chevrolati,* the only other *Copelatus* so far taken at Key West, is easily distinguished from *blatchleyi*

by having a submarginal and eight other striae on each elytron.

DIAGNOSIS: A small, ovate, moderately convex *Copelatus* with a distinct submarginal and five other distinct striae on each elytron (Sharp's Group 9). The structure of the male aedeagus is diagnostic (Fig. 1) and indicates the relationship of the species to *debilis* Sharp (Fig.2). The latter, however, is smaller, more elongate, less convex, less coarsely punctate, and the aedeagus differs in structure. Average length 4.63 mm.; average width at middle of elytra 2.43 mm.

HOLOTYPE MALE: Elongate oval, greatest width at about middle of elytra, moderately convex dorsally. Total length 4.73 mm.; greatest width 2.43 mm. Width at base of pronotum 2.19 mm.; width at apex of pronotum 1.30 mm.; length of pronotum at midline 0.86 mm. Length of prosternal process 0.76 mm.; length from apex of prosternal process to apex of coxal laminae 1.57 mm. Width between eyes 0.78 mm. *Head*: Microreticulate and moderately finely punctate, punctures on vertex separated by from 2 to 3 times their diameter (coarser punctures in usual position for genus). *Pronotum*: Microreticulation and punctation on disk about as on head; coarser punctures along anterior margin, laterally, and in two depressions near the base on either side of middle. *Elytra*: Microreticulation coarser and more irregular than on head and pronotum; punctures along suture and between the impressed striae coarser and denser than on head or pronotum. Each elytron with a submarginal and five other distinct, deeply impressed striae; no sutural stria; first discal stria about twice as distant from the suture as from the second stria; first and second striae a little shorter at base than outer three; second and fifth striae somewhat abbreviated toward the apex (the fifth showing a tendency to turn inward and almost join the fourth toward the apex); submarginal stria originating just before middle of elytra and extending a little beyond termination of the 5th discal stria. *Venter*: Metasternum, coxal plates, and abdominal sternites microreticulate and with some parallel scratches, but not conspicuously punctate in any part. Prosternal process similar to that of

debilis, but relatively stouter and more expanded behind the anterior coxae. *Anterior* and *middle tarsi* moderately dilated; protarsal claws simple. *Anterior tibiae* constricted at base as in *debilis*. *Genitalia*: Parameres similar to those of *debilis*. Aedeagus distinctive (see Fig. 1). *Color*: Head reddish brown, eyes dark. Pronotum dark reddish brown to fuscous on disk, lighter yellowish brown at anterior angles and along margins. Elytra very dark reddish brown to fuscous with a narrow, transverse yellowish brown area at base not quite reaching the suture; margins and apices diffusely lighter. Appendages and undersurface nearly uniformly reddish brown, a little darker along sutures and on abdominal sternites.

ALLOTYPE FEMALE: Similar to male except that specimen is teneral and almost uniformly light yellowish brown above and below. The specimen is in poor condition, but the structural characters are distinct. The anterior and middle tibiae and tarsi are simple. Total length 4.59 mm.; greatest width 2.40 mm. Width of pronotum at base 2.11 mm.; width of pronotum at apex 1.24 mm.; length of pronotum at midline 0.81 mm. Length of prosternal process 0.70 mm.; length from apex of prosternal process to apex of coxal laminae 1.51 mm. Width between eyes 0.78 mm.

VARIATION: The series of specimens before me is relatively uniform. Both of the females are teneral and lighter in color, but do not seem to differ significantly otherwise. The largest male measures 4.75 by 2.54 mm.; smallest female 4.56 by 2.38 mm.

TYPE LOCALITY: Holotype, allotype, two male and one female paratypes, all from FLORIDA: Monroe County, Key West, Mar. 3, 1919, W. S. Blatchley. (These apparently represent all but four of the specimens collected by Blatchley and recorded by him as *debilis*.)

LOCATION OF TYPES: Holotype and allotype in the W. S. Blatchley Collection at Purdue University. One male and one female paratype in the University of Michigan Museum of Zoology, Ann Arbor, Michigan. One male paratype in the Museum of Comparative Zoology (Type No. 29,019), Cambridge, Massachusetts.

THE BIOLOGY OF *BRACHYPANORPA* (MECOPTERA)[1]

By F. M. Carpenter
Harvard University

The Genus *Brachypanorpa*, as now known, consists of only three species, all confined to the United States: one in the southern Appalachian region and two in the northwestern region. The distinctive features of the genus are the absence of the long rostrum characteristic of other Mecoptera and the reduction of the wings in the females. The most closely related genus—and indeed the only one which shows any affinities at all with *Brachypanorpa*—is *Panorpodes*, known only from Japan. The species of the latter, however, possess a distinct rostrum and fully developed wings in both sexes.

Virtually nothing has been known of the general biology of either of these two genera. Japanese entomologists have attempted to rear larvae of *Panorpodes*, but without success. During the past two years Dr. F. Y. Cheng and I have made observations on the habits of *Brachypanorpa carolinensis*, both in the field and laboratory, and have been able to work out part of its life-history. The present paper includes our observations on the adults of this insect and brings together some notes on the distribution of all three species of the genus. In another paper Dr. Cheng will give an account of the larva of *carolinensis*.

Brachypanorpa carolinensis (Banks)[2]

This species was first taken by William Beutenmüller in the Black Mountains, North Carolina, on May 26, 1903, and was described by Banks in 1905 (as *Panorpodes carolinensis*) from seven males in Beutenmüller's collection.

[1] Published with a grant from the Museum of Comparative Zoology at Harvard College.

[2] For the nomenclature of *Brachypanorpa*, see my revision of the Nearctic Mecoptera (Bull. Mus. Comp. Zool., 72:205-277, 1931).

The exact localities in the Black Mountains at which Beutenmüller found his specimens are not known, but it is clear from a short note published in 1903 that his collecting was done in the southern half of the Black Mountain range. On subsequent trips he took many additional specimens of the species in that range. In late May, 1905, Nathan Banks made a trip to the same region, but most of his collecting was done along the North Fork of the Swannanoa River,[3] a few miles north of the town of Black Mountain and just east of Craggy Knob, in the Craggy Mountain range. At this locality Banks collected a great many specimens of *carolinensis*, including the first females. The latter he mentioned in a paper published in 1911, stating that they had very short wings, were unable to fly, and hopped about very lively. Additional females were subsequently taken by Beutenmüller in the Black Mountains.

Other localities for the species were added by R. W. Leiby, who found it abundant near the top of Mt. Mitchell, the highest peak (6700′) in the Black Mountains (July, 1919), and who also collected it in the Craggy Mountains (June, 1920) about six miles from the Black Mountains and only three miles from Banks' locality along the North Fork of the Swannanoa. It was also found by F. Sherman at Linville Falls (4000′, late May and June, 1920) in the Blue Ridge Mountains, twenty miles northeast of the Black Mountain range.

So far as I am aware, *carolinensis* was not collected again for about thirty years, until May, 1951, when Dr. Cheng, Dr. W. Nutting, Dr. K. Christiansen and I secured many specimens at Carolina Hemlock Camp on the edge of the Black Mountains, and brought back alive 150 males and seven females to Cambridge for study. By what is certainly a striking coincidence, at about this same time (May 17, 1951), several specimens were collected by Dr. P. W. Fattig at Unicoi Gap in Georgia (near the town of Robertson). In May, 1952, Dr. Cheng and I again visited the Black Moun-

[3] Banks' labels for this locality read, "Black Mt., North Fork Swannanoa". It should be noted that the town of Black Mountain is not in the Black Mountains, but is about twenty miles south of that range.

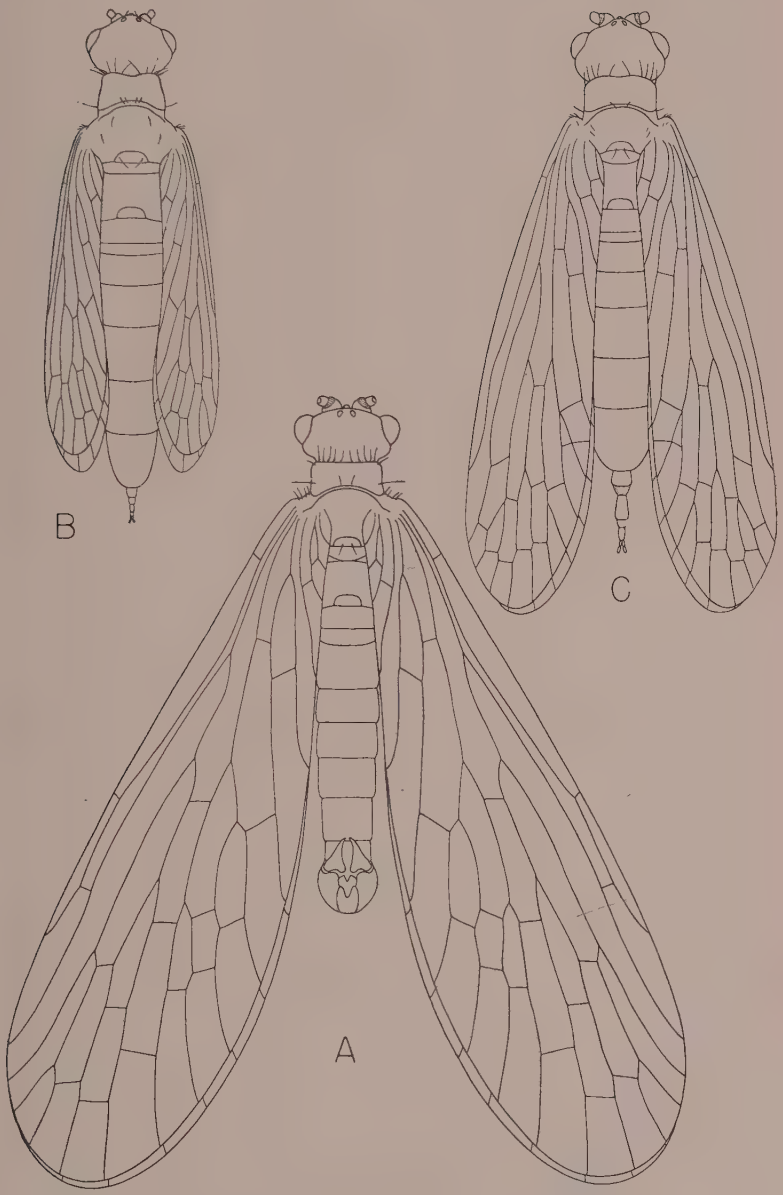
tains. Both sexes of *carolinensis* were active when we reached Carolina Hemlock Camp on May 15. The males remained abundant until June 1, but the females were numerous only on May 20th. Specimens of both sexes were collected at many places in the Black Mountains, including Cobert Creek, towards Deep Gap; along White Oak Creek; along Laurel Fork, near Busick; along South Toe River towards Bald Knob Ridge; at Potato Knob and Stepp Gap (Beutenmüller's localities). Specimens were also found at Craggy Gardens, in the Craggy Mountains. On May 23, 24 and 25, P. W. Fattig and I found many specimens at Unicoi Gap, at Henson Gap, and on Blue Mountain, Georgia (all between 3600′ and 4000′ elevation).

The history of the collecting of this insect has been given in detail above because it contributes significant evidence to our understanding of a change that seems to have taken place in the female population. As stated above, the females of the three known species of *Brachypanorpa* have smaller wings than the males (see Plate 2). The real notable aspect of the record of *carolinensis* is that all of the females (20 specimens) known to me to have been collected from 1903 to 1920 have wings which do not reach to the end of the abdomen (see Plate 2, fig. B) and which were so small in area that the insects (according to Banks) were flightless and could only hop about; whereas all the females (80 specimens) which Dr. Cheng and I collected in 1951 and 1952 at the previous localities, as well as new ones, have wings which extend beyond the end of the abdomen (see Plate 2, fig. C) and which have such an area that the insects were able to fly distances of several feet.

Since the males taken over the entire period show no differentiation and the females exhibit no differences except in wing size, I believe we are dealing here with a single species, the female population of which has under-

EXPLANATION OF PLATE 2

Brachypanorpa carolinensis (Banks). A. Drawing of male from Carolina Hemlock Camp, North Carolina. B. Drawing of female from Black Mt., N. Fork of Swannanoa, North Carolina (1905). C. Drawing of female from Carolina Hemlock Camp, North Carolina (1951). All drawings are to scale.



CARPENTER — BRACHYPANORPA CAROLINENSIS

gone a marked change in the past thirty years. Although the long winged females may have been present as a small minority in the population before 1920, they are now clearly the majority in the same population. The reverse applies, of course, to the short winged females. It is conceivable that the long winged females, which are able to fly short distances and which might, therefore, more readily find males, have a definite selective advantage over the flightless females. This could account for such a change taking place in the course of a maximum of 30 generations.

The distribution of *carolinensis* presents some interesting features. Its most northern record is now Linville Falls, North Carolina, and its most southern near Unicoi Gap, Georgia. The species seems to be confined to the narrow strip of mountainous country, about 120 miles long, between these two places. However, even in this area, the species appears to be local except for the Black Mountains, where it occurs more generally. With the possible exception of one individual (the data on which are questionable), all specimens of the species so far known to me have been collected at elevations between 3000 and 6700 feet. At the lower elevations, as at Carolina Hemlock Camp (3000′), both male and female adults occur as early as May 15, but virtually all disappear by June 4. At higher elevations (such as 6000′), the adults do not appear until early July; both sexes have been taken as late as July 18 on the top of Mt. Mitchell (6700′).

The species occurs only in shady woods, where the soil is moist, though without any definite plant associations. *Galax, Rhododendron,* Jack-in-the-Pulpit, jewel weed, asters and May apple occur commonly where *carolinensis* is found, but these plants are characteristic of nearly all moist woods in the southern Appalachian region. Some of them, however, may be necessary as food for the adults of *carolinensis*. Our first efforts to keep the adults alive in cages failed completely because we did not find anything on which they would feed. Bits of animal flesh or of dead insects, which *Panorpa* and *Neopanorpa* readily consume, were not eaten by *carolinensis*. Subsequent observation showed that they fed on the epidermis of soft leaves, such as those of aster

and jewel weed, by scraping the surface of the leaves with their mouth-parts. Caged specimens furnished with fresh leaves lived through the life span of adults in their natural environment.

The males of *carolinensis* fly much like those of *Panorpa,* though usually not quite so far. The females, after pupal ecdysis, crawl up the stems of low-growing plants, and spend much of the time on the ventral surface of the leaves. This undoubtedly explains why so relatively few females have been found. When disturbed, the females will fly, usually downward, to another leaf or to the ground. Mating takes place on the leaves, usually on the upper surface. Complicated courtship, like that in *Panorpa,* is entirely absent; the male quickly approaches and grasps the female with his terminal forceps. Mating usually occurs in the evening, but may take place anytime during the day. A day or two after mating, the female works the tip of her abdomen into the soil and lays a loose mass of white eggs. Details of egg structure and development will be given by Dr. Cheng with his account of the larva.

Brachypanorpa oregonensis (MacLachlan)

This species was first collected on Mt. Hood, Oregon, in 1881, and was described by MacLachan the same year from males only. The males differ from those of *carolinensis* chiefly by having several long ocellar bristles, absent in the latter. The females, first described by Carpenter (1931), are flightless, the wings being only as long as the thorax (Text fig. 1B).

B. oregonensis has now been found at many localities in the western half of Oregon, in the area extending nearly the full width of the state and about 130 miles inland from the coast. Unlike *carolinensis,* which has been found only at relatively high elevations, *oregonensis* occurs all the way from about sea-level (*e.g.,* Glenada and Walport) to as high as 7000 feet at Crater Lake. Also the seasonal range of the adults is much greater than for *carolinensis.* At relatively low elevations (up to 1000′), the adults have been found from April 20 to June 22; at higher elevations (3000-7000′), from June 19 to August 4. Although there

are no observations on the occurrence of *oregonensis* over a period of several weeks at any one locality, the foregoing records suggest either a longer period of adult life than in *carolinensis* or a greater seasonal period of emergence from the pupae.

A few specimens of this insect have been found outside the state of Oregon. One male (now in the Museum of Comparative Zoology) was collected on the northern Californian coast (Patrick's Point State Park, Humboldt Co., June 2, 1950, W. L. Nutting and F. Werner); another (in the California Academy of Sciences) was taken in northern Idaho, almost at the Canadian border (Coolin, Priest Lake, July 15, 1927, E. C. Van Dyke.[4] The most surprising record is a male (in the U. S. National Museum) from eastern Utah (Neola, near Vernal, July 13, Harmston). A more extensive series of specimens of *Brachypanorpa* from these northwestern states may show that more than one species is involved in this population, though structural details of both sexes seem notably constant.

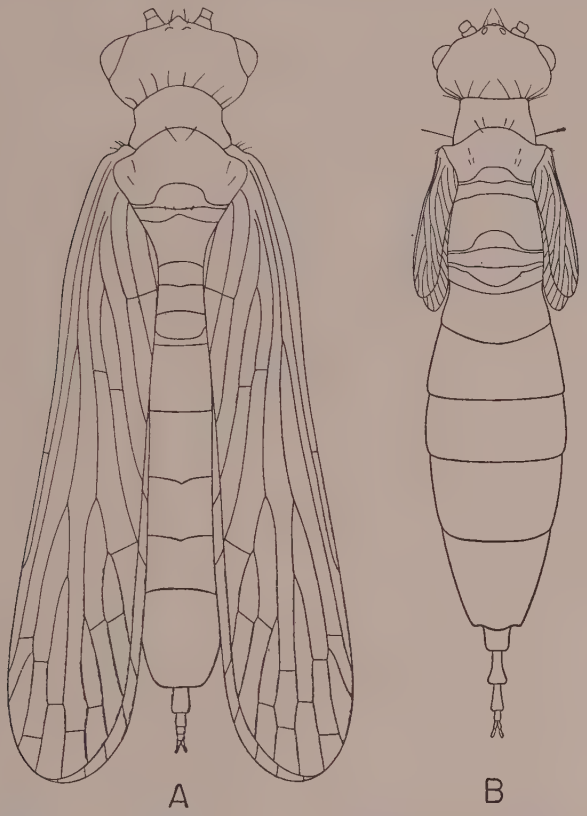
Brachypanorpa montana Carp.

This species was originally based on nine males from Mt. McLoughlin, Klamath Co., Oregon, 8000-9000 feet elevation (July 19, 1930, H. A. Scullen). They were specifically separated from *oregonensis* chiefly on their darker color, since the males of *Brachypanorpa*, like those of *Panorpodes* (Japan), appear to show no marked structural differences between species. Subsequent examination of more specimens of *Brachypanorpa* from Oregon convinced me that the coloration was not a reliable characteristic and that *montana* was a synonym of *oregonensis*.[5] Since then a female *Brachypanorpa*, having a very dark body and wings which extend beyond the abdomen (Text-fig. 1, A), has been collected at Lake of the Woods, Klamath Falls, Oregon

[4] I am indebted to Dr. E. S. Ross for the loan of this specimen.

[5] Records and Notes of Nearctic Mecoptera and Raphidiodea. Bull. Brooklyn Ent. Soc., 34(3):163 (1939).

(5100′, July 5, 1946, B. Malkin).[6] There are several reasons for considering this female a representative of a species distinct from *oregonensis;* and since it was collected near the type locality of *montana,* as pointed out by Miss Parfin, I now believe it advisable to re-instate the latter as



Text-figure 1. A. *Brachypanorpa montana* Carp., drawing of female from Mt. McLoughlin, Oregon. Actual length of specimen, 8.7 mm. B. *Brachypanorpa oregonensis* (McLach.), drawing of female from Mary's Peak, Oregon. Both drawings are to scale.

[6] I am indebted to the U. S. National Museum for the loan of this specimen, which was briefly noted by S. Parfin (Proc. Ent. Soc. Washington, 49:258, 1947).

a valid species and tentatively to assign this female there. Additional collecting, or better still, rearing experiments, will undoubtedly clarify the relationship of this female, of the males described as *montana,* and of *oregonensis.* The most interesting aspect of this female, and my reason for mentioning it here, is its analogy with the long winged females of *carolinensis,* described above. There clearly exist or have existed in both the eastern and western populations of *Brachypanorpa* long winged and short winged females. The collecting data on *carolinensis,* given in some detail above, suggest that the long winged female is now the dominant, if not the only, form in existence in the eastern population. Comparable data on the western females have not been obtained, but I believe the occurrence of even the single long winged female shows that a similar genetical trend, (*i.e.,* towards the development of both short winged and long winged females) has existed in both populations. More intensive collecting of *Brachypanorpa* in Oregon, especially at one locality over a whole season, might furnish data indicating even further similarities.

TWO NEW OREGON CHILOPODS OF THE ORDER GEOPHILIDA

By Ralph V. Chamberlin
University of Utah

Representatives of the two new centipeds described below were found in a collection belonging to the Oregon State College and submitted to me for study through the courtesy of Vincent D. Roth of that institution.

Himantariidae

The genus *Stenophilus* was proposed several years ago by the writer for several species of this family occurring in western America which, while obviously related closely to the European genera *Meinertophilus* and Latzel's *Stigmatogaster* (*Haplophilus* Cook), present some characters which would require substantial emendation of those genera to permit inclusion of the American forms. I am, therefore, retaining for our species the name *Stenophilus,* emended now from the original definition in the light of new species subsequently discovered. *Stenophilus* as far as now known differs from the European genera mentioned in lacking conspicuous sclerotic or chitinous lines on the prosternum and in lacking all paratergites. In *Stenophilus* ventral pores may be absent, present on a few anterior sternites, or on sternites of approximately the anterior half of the body (*rothi* n. sp.). Sternal pouches such as are present in nearly all, if not all, European species of the genera mentioned, have been detected in American forms only in *S. coloradanus* Chamb., in which they occur on segments 25 to 35.

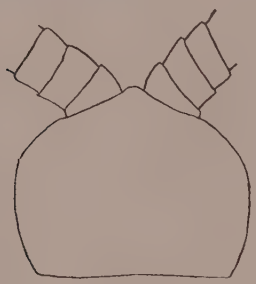
American species referred to *Stenophilus* are now known from Colorado, Idaho, Montana, Oregon and California. They seem to be replaced farther south by species of *Gosiphilus* which are common in Mexico and the border states from California to Louisiana. From these species those of *Stenophilus* are readily distinguished by the deeper, more angular, embayment of the labrum with its much stouter

teeth as well as by the details of the coxopleural region at caudal end.

Stenophilus rothi new species

Body and legs yellow throughout, the head but little darker. Head much wider than long (ad 11.5:9) and of the form shown in fig. 1. Antennae flattened, contiguous at base, the articles proportionately short and broad, the last one subequal to the two preceding taken together.

Median excavation in labrum cutting through to base, the eight median teeth large and strongly sclerotized and laterad from these one or two weaker teeth or serrations on each side as show in fig. 2. Coxosternum of second maxillae with anterior indentation or excision of form shown in fig. 3.



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Stenophilus rothi n. sp. Fig. 1. Head in outline. Fig. 2. Labrum, with lateral ends omitted. Fig. 3. Second maxillae.

Dorsal plates plainly bisulcate but the sulci not sharply impressed. Ventral pores in a transverse, narrowly oblong and clearly limited area behind middle of sternites of anterior half of body. Last sternite narrowly trapeziform; prepleurites present on last segment. Coxal pores small

and numerous, present over entire surface. Anal legs inflated in the male, the last article conically tapered. Pairs of legs, 73.

Length of male holotype, 41 mm.

Localities. — Oregon: Marion Co., Silver Creek Falls, male holotype taken by V. Roth on May 12, 1951. Montana: St. Regis, female allotype taken Sept. 23, 1950, also by Roth.

GEOPHILIDAE

Brachygeophilus tampophor new species

Body and legs yellow throughout.

Head a little longer than broad; sides over middle of length gently convex, more strongly rounding in at ends, the caudal margin straight; overlapping the basal plate.

Claws of the prehensors when closed reaching distal end of first antennal article; armed at base with a distinct acute tooth; the other articles and the prosternum unarmed. Prosternum without sclerotic or chitinous lines.

No clypeal areas. Clypeus with three pairs of submedian setae, of which the setae of the anterior pair are farther apart than those of the median, and those of the median pair than the most caudal. Median piece of clypeus bearing typically 7 long conical teeth.

Spiracles all circular. Last ventral plate moderately wide. Coxal pores 5 on each side, the two innermost of which may be partly covered by the ventral plate. Anal pores not detected. Pairs of legs 39 except in one specimen in which there are 47 pairs.

Length, 15 to 20 mm.

Locality. — Oregon: Tombstone Prairie, Santiam Pass. Seven specimens taken Aug. 13, 1949, by V. Roth.

This form differs from other western American species, excepting *B. anonyx,* in having the claw of the prehensors armed at base. From *B. anonyx* it differs in having the anal legs armed with claws as well as in the smaller number of legs.

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